PARENTAL CARE IN *ERIXESTUS WINNEMANA* (HYMENOPTERA: PTEROMALIDAE), AN EGG PARASITE OF *CALLIGRAPHA* (COLEOPTERA: CHRYSOMELIDAE)[1]

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ABSTRACT: Parental care is very rare among parasitic Hymenoptera. We report the first evidence of parental care in *Erixestus winnemana* (Hymenoptera: Pteromalidae), a native pteromalid egg parasite of *Calligrapha*, (Coleoptera: Chrysomelidae), in the United States. *Erixestus winnemana* protects her eggs from other parasites and hyperparasite *Apostocetus* sp. (Hymenoptera: Eulophidae).This behavior is also exhibited on Colorado potato beetle, *Leptinotarsa decemlineata*, eggs.

Erixestus winnemana Crawford is an egg parasite of *Calligrapha* in the United States. Our interest in *Erixestus* was to determine its potential as a biocontrol agent for the Colorado potato beetle, *Leptinotarsa decemlineata* (Say); *Calligrapha* and *Leptinotarsa* belong to the same subtribe, Doryphorina, in tribe Chrysomelini, and therefore may be hosts for the same parasites. On July 6, 1992 we collected egg masses of *C. spiraceae* (Say) from ninebark, *Physocarpus opulifolius* (L.), a woody shrub found along stream banks near Flintstone, Washington County, MD. Here we observed *E. winnemana* exhibiting parental care on one of the egg masses.

In this paper, we report the first evidence of parental care in *E. winnemana* parasitizing *C. spiraceae*. *Erixestus winnemana* exhibited the same behavior on *C. multipunctata* (Say), *C. philadelphica* (L.), and *L. decemlineata* eggs in the laboratory. We also describe the behavior of *Erixestus* against the hyperparasite, *Aprostocetus* sp.

MATERIALS AND METHODS

The beetles, parasites and hyperparasite were all reared at 24°C, at 50-60% RH and 16L : 8D photoperiod in our laboratory. *Calligrapha multipunctata* was collected in Johnson County, Arkansas and reared in the laboratory on black willow, *Salix nigra* Marsh. *Calligrapha philadelphica* was collected near Flintstone, Washington County, MD and reared on red willow *Cornus amomum* Mill. in the laboratory. *Calligrapha spiraceae* was also collected near Flintstone and reared on ninebark in the laboratory. *Leptinotarsa decemlineata* egg masses were obtained from a laboratory colony of the beetle. *Erixestus* were reared in wide-mouth 3.8 liter glass jars streaked with honey and 5% honey water. Labo-

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ratory reared *Calligrapha* egg masses were placed in the jar and exposed to parasites for 24 hrs. They were removed and incubated until the parasites emerged in 10-13 days. Egg masses collected in the field were incubated in the laboratory for the emergence of parasites and hyperparasites. The hyperparasite, *Aprostocetus*, was reared in the laboratory by exposing it to parasitized *Calligrapha* eggs for 24 hours in a petri dish.

Behavioral observations were conducted in the following manner. An egg mass from a particular species of beetle was placed in a small petri dish with an *Erixestus* female until she parasitized several eggs, at which time a female hyperparasite or other *E. winnemana* females were added and observations on their behavior were made. In addition, 2-3 females were placed in a small petri dish with multiple egg masses to observe the behavioral response to more than one egg mass. All observations were made directly through a microscope or recorded on VCR tape and viewed later.

RESULTS

The general parental care behavior pattern of *E. winnemana* observed on egg masses of the three *Calligrapha* species and on *L. decemlineata* was as follows. When the *Erixestus* female is first placed in a petri dish, she searches for an egg mass and begins drumming it with her antennae (Fig. 1-a). Several seconds later she proceeds to insert momentarily her ovipositor approximately 1/3 of its length, withdraws it and feeds on the exuding yoke (Fig. 1-b). She then inserts her ovipositor again for several seconds, but this time to its full length. At this point she becomes very protective of the egg mass, which she will guard until her young emerge (ca. 10-13 days) (Fig. 1-c). She may continue to oviposit in other eggs in the mass, but she does not willingly leave it for another egg mass. When other females approach the mass she makes herself look bigger by extending her wings, and lashing out at the intruder (Fig. 1-d). She responds in the same way if approached by an inanimate object such as a brush. If the intruder does not retreat, a fight ensues for several seconds (Fig. 1-e). At this point, she either wins and the intruder leaves or she is injured/killed. If she survives, she grooms herself and flexes her body by rising up and down on the egg mass (Fig. 1-f). If she loses, the egg mass is abandoned and the new female takes over. The old female will then move to another mass that has not been parasitized or fight for the possession of it.

The parasite's response to hyperparasites is the same as previously described. *Aprostocetus* sp. is more patient and persistent in its attempt to get on the egg mass. It will very slowly circle around the mass, make a few attempts to get on the egg mass, and if the female is resting or in the process of ovipositing, the hyperparasite will quickly mount the egg mass and immediately oviposit. But when the female is again aware of the hyperparasite, she chases it off the mass.

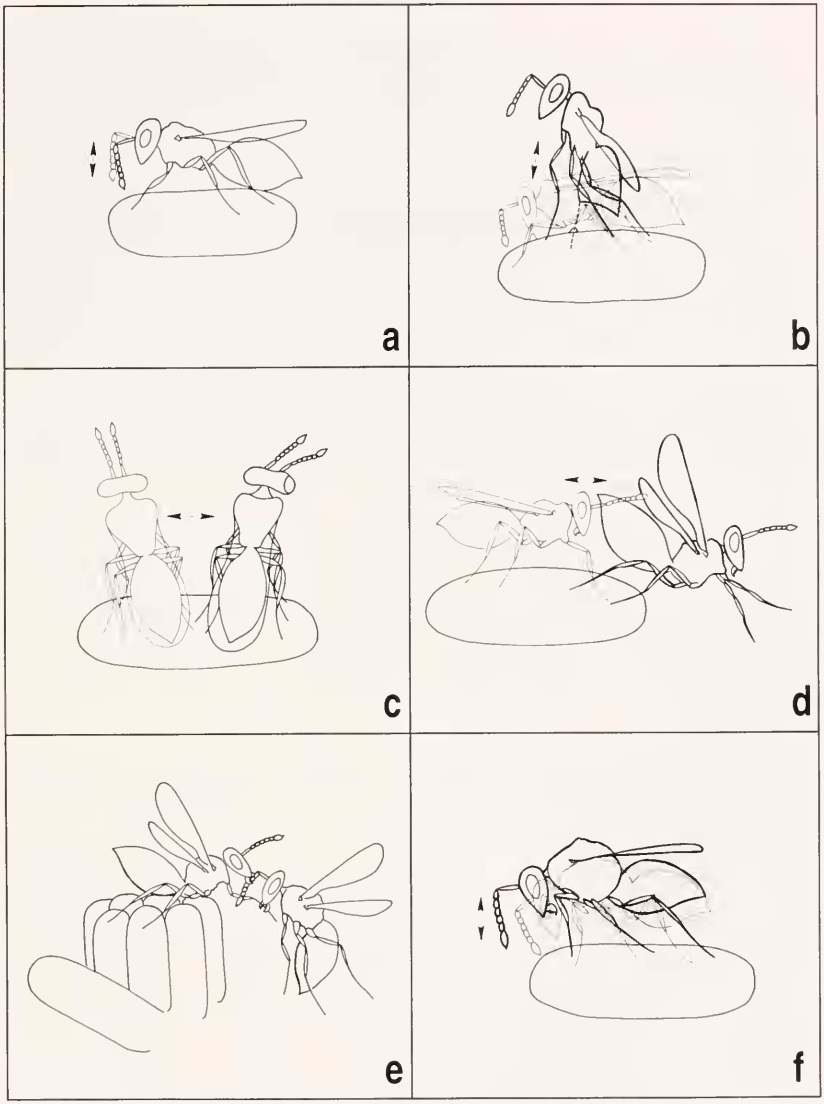

Fig. 1. Schematic of parental care behavior patterns of *Erixestus winnemana* Crawford, on eggs of *Calligrapha* and *Leptinotarsa decemlineata*. (a) Drumming egg with antennae. (b) Partial insertion of ovipositor. (c) Oviposition and beginning of guarding the egg mass. (d) Protection of egg mass. (e) Combating behavior. (f) Grooming and flexing on egg.

DISCUSSION

Parental care in insects ranges from passive egg guarding to complex grooming, feeding, protective, and nesting behaviors. Tallamy and Wood (1986) categorize parental care into 3 primary behaviors: 1) physical protection of offspring from danger, 2) protecting resources vital to offspring; and/or 3) facilitating offspring feeding. In our study, *E. winnemana* physically protected the parasitized egg mass from hyperparasitism, and competition by other parasites.

According to Tallamy and Wood (1986), the costs of parental care include: 1) the defense of offspring, at the risk of physical injury or death; 2) offspring clustered in one spot may be more attractive to parasites and predators than isolated ones, and 3) the evolutionary decision to invest more time in a few progeny versus minimal amount of time on many. The costs of parental care for *E. winnemana* are very similar to those mentioned by Tallamy. For instance, in the laboratory we demonstrated that the female protects her offspring from hyperparasitism and superparasitism of the host eggs, protection that can result in the female's death. Also, the female makes the decision to remain on the egg mass she has parasitized until the eggs hatch or she loses possession of it. Here again, she invests more time to protect a few offspring versus moving on to oviposit in other scattered egg masses. In nature, *E. winnemana* oviposits her eggs in a mass averaging 2-7 eggs/mass on the underside of leaves. These egg masses are sparsely scattered on ninebark shrubs found along the stream banks. We did not observe more than one parasite on an egg mass in nature. Daviault (1941) reported on *E. winnemana* as an egg parasite of *C. bigsbyana* and *C. scalaris,* but did not mention parental care in his discussion of the biology of the parasite.

Parental care is very rare among hymenopterous parasites. Most parasites usually oviposit on/in or near a suitable host and then leave without paying any further attention to their progeny. However, there are a few species where the female protects her progeny until they mature. There is only one known instance in the Ichneumonoidea, where the braconid, *Cedria paradoxa,* attacks the larvae of the pyralid moth, *Hapalia machaeralis,* in India (Beeson & Chatterjee 1935). In this case, a single braconid female parasitizes one caterpillar and guards the offspring from the egg to adult stages or until her death. Several bethylid species also exhibit parental care, when the female remains with her progeny, defending them against predation, hyper-, super- and multiple parasitism (Gordh & Hawkins (1981), Doutt (1973), Bridwell (1919), Kuhne & Becker (1974), Gerling (1979), and Hardy & Blackburn (1991). Here we have demonstrated a new form of subsocial behavior in parasitic Hymenoptera, specifically in the pteromalids.

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